REMARKS

Claims 1-12, 13, and 15-19 are currently pending in the application. In the above amendment, Applicants' representative has added 20-27 to provide device claims that mirror the method claims 1-12, which the Examiner has indicated are allowable. In an Office Action dated October 1, 2003 ("Office Action"), the Examiner rejected claims 13 and 15-17 under 35 U.S.C. § 103(a) as being unpatentable over Carter et al, U.S. Patent No. 5,909,540 ("Carter"), and rejected claims 18-19 under 35 U.S.C. § 103(a) as being unpatentable over Carter in view of Mutalik et al., U.S. Patent No. 6,161,111. The Examiner indicated that claims 1-12 are allowable, for which Applicants' representative wishes to thank the Examiner.

In the above amendment, Applicants' representative has endeavored to ensure that device claims that mirror the already allowed method claims are included in the application, for completeness. Applicants' representative believes that these claims should be allowable for the same reasons that original claims 1-12 are allowable. However, Applicants' representative respectfully traverses the rejection of claims 13, and 15-19.

Claim 13 is provided below, for the Examiner's convenience:

> 13. A mass storage device that provides logical device units to accessing computers, the mass storage device comprising:
> a medium for storing data;
> data writing and reading devices for writing data to the medium and reading data from the medium;
> memory and logic processing components; and
> a controller that executes within a logic processing component and controls reading and writing of data to and from the memory and to and from the medium, the controller providing, in addition to execution of I/O operations, including execution of read and write operations to and from logical device units comprising portions of the medium for storing data, *mirroring of an object stored on a first logical device unit to a mirror object stored on a second logical device unit* and a current state metric for each logical device unit that can be requested by an accessing computer, the controller updating the current state metric for a logical device unit whenever the controller executes an I/O operation that changes the data, stored on the medium for storing data, included in the logical device unit's data. (emphasis added)

Interestingly, in the background of the invention section of Carter, Carter states: "Disk mirroring provides highly fault tolerant storage but is expensive, since multiple disks,

usually two, must be provided to store the data of one disk." In essence, Carter is pointing out disadvantages in prior art techniques – presumably techniques different than the techniques he is about to disclose and claim. Applicants' representative read through Carter in its entirety, but could not find a reference to mirroring. Applicants' representative believes that, in fact, Carter avoid employing mirroring in his system, as intimated by the above-quoted statement. Instead, Carter employs page-level replication:

The file system 60 takes advantage of the page level replication capability of the underlying distributed addressable shared memory system 20 disclosed in the U.S. patent application incorporated by reference above. Page level replication allows the system to provide file replication. The data streams of a replicated file are backed by pages, which are themselves replicated. In this way, data streams are replicated automatically without intervention of the file system 60 (column 12, line62 – column 13, line 3). Applicants' representative submits that page-level replication is not mirroring, and not related to mirroring. Object-level mirroring is described in the current application beginning at line 24 of page 4:

> In one well-known technique, a primary data object is mirrored. Figure 3 illustrates object-level mirroring. In Figure 3, a primary data object "O_3" 301 is stored on LUN A 302. The mirror object, or backup copy, "O_3" 303 is stored on LUN B 304. The arrows in Figure 3, such as arrow 305, indicate I/O write operations directed to various objects stored on a LUN. I/O write operations directed to object "O_3" are represented by arrow 306. When object-level mirroring is enabled, the disk array controller providing LUNs A and B automatically generates a second I/O write operation from each I/O write operation 306 directed to LUN A, and directs the second generated I/O write operation via path 307, switch "S_1" 308, and path 309 to the mirror object "O_3" 303 stored on LUN B 304. In Figure 3, enablement of mirroring is logically represented by switch "S_1" 308 being on. Thus, when object-level mirroring is enabled, any I/O write operation, or any other type of I/O operation that changes the representation of object "O_3" 301 on LUN A, is automatically mirrored by the disk array controller to identically change the mirror object "O_3" 303. Mirroring can be disabled, represented in Figure 3 by switch "S_1" 308 being in an off position. In that case, changes to the primary data object "O_3" 301 are no longer automatically reflected in the mirror object "O_3" 303. Thus, at the point that mirroring is disabled, the stored representation, or state, of the primary data object "O_3" 301 may diverge from the stored representation, or state, of the mirror object "O_3" 303. Once the primary and mirror copies of an object have diverged, the two copies can be brought back to identical representations, or states, by a resync operation represented in Figure 3 by switch "S_2" 310 being in an on position. In the normal mirroring operation, switch "S_2" 310 is in the off position. During the resync operation, any I/O operations that occurred after mirroring was disabled are logically issued by the disk array controller to the mirror copy of the object via path 311, switch "S_2," and pass 309. During resync, switch "S_1" is in the off position. Once the resync operation is

> complete, logical switch "S_2" is disabled and logical switch "S_1" 308 can be turned on in order to reenable mirroring so that subsequent I/O write operations or other I/O operations that change the storage state of primary data object "O_3," are automatically reflected to the mirror object "O_3" 303. (emphasis added)

As can be easily seen in the above quoted passage, object-mirroring involves stringent constraints on all access operations, and that the controller at least attempts to maintain an object and its mirror in lockstep synchrony. Mirroring involves enabling, disabling, and resync operations, none of which are taught, mentioned, or suggested by Carter. Nothing in Carter suggests that mirroring is employed for page-level replication, and Carter, in fact, suggests strongly that is not. Moreover, Carter explicitly states that "data streams are replicated automatically without intervention of the file system." Thus, the Examiner's references to timestamps in file system Inodes, and other inferences drawn from file-system features, are irrelevant. Carter's file system is not involved in object-level replication.

The Examiner refers repeatedly to column 18, lines 3-8:

> The systems can also include a coherent replication controller for generating a copy, or select number of copies, of a *portion of the addressable memory space* maintained in the local persistent memory device of a first computer and for storing the copy in the local persistent memory device of a second computer.

As can be understood from the emphasized text, along with material previously quoted from Carter, replicating a portion of the addressable memory space is not mirroring, and not related to mirroring. Object-level mirroring, clearly claimed in claim 13 and described in the above-quoted passage from the current application, involves an exact copy of an entire object that is maintained, to as great as extent as possible, in lockstep synchrony with the original object. Replicating a portion of an addressable memory space is not mirroring. An address space may contain many hundreds, thousands, or millions of logically distinct objects, and, since the file system is not involved in replication, but only underlying memory pages, logical objects cannot be exactly replicated, since objects may span page boundaries. Moreover, Carter does not provide for the replication to be turned on and off, and for resync operations. Replicating a portion of something is simply not mirroring.

For these reasons, Applicants' representative believes that Carter is

unrelated to claim 13, and claims 15-19 that depend from claim 13, and that claims 13 and 15-19 are not obvious in view of Carter, or Carter combined with other references.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,
Robert Alan Cochran and Harald Burose
Olympic Patent Works PLLC

Robert W. Bergstrom
Registration No. 39,906

Enclosures:
Postcards
Transmittal in duplicate

Olympic Patent Works PLLC
P.O. Box 4277
Seattle, WA 98194-0277
206.621.1933 telephone
206.621.5302 fax